Space Weather Technical Forecast

Issued on Tuesday, 05 September 2023 at 01:28 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of isolated M-class flares throughout. Slight chance of G1/Minor Storm conditions day 1 (05 Sep).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with frequent, mainly low-level C-class flares. A peak long-period C6.6 flare was observed at 04/1106 UTC from AR3413 located over the northwest limb. The majority of other flaring has occurred from AR3421, approaching centre disc in the northern hemisphere.

Eight sunspot regions are present on the Earth-facing side of the sun. AR3421 (Dai/Beta-Gamma) has developed most during the period, with frequent minor C-class flaring along with increased magnetic looping across the region and spot emergence. Elsewhere on the disc, most regions have remained stable or are showing some signs of decay with only a couple of new areas of growth. An area in the northeast has been numbered AR3422 (Dro/Beta) and has seen some new spots develop, but has recently stalled in its growth. Another region, AR3423 (Bxo/Beta) has emerged from an area of plage in the far northeast. This region appears to be developing further small spots at it rotates into clearer view. All other regions are small and simple unipolar or bipolar groups.

A C2.4 flare peaking at 04/1349 UTC from an area of plage in the southeast resulted in a CME evident in LASCO and STEREO imagery. This is currently being modelled but is expected to pass behind Earth. Otherwise no Earth-directed CMEs were detected in available coronagraph imagery.

Solar Wind / Geomagnetic Activity: The solar wind environment was indicative of the gradual easing of the fast wind of CH40/+ with speeds reducing from around 450km/s to 360-400km/s by the end of the UTC day on 04 Sep. Density was largely at average levels through the first half of the UTC day, before becoming mainly below average thereafter. Total Interplanetary Magnetic Field (IMF), Bt, was generally Weak, varying between 3-6nT. The north-south direction, Bz, also varied weakly (between +/-4nT) with periodic fluctuations between negative (southward) and positive (northward) direction. Phi angle was broadly neutral, with no prolonged periods in either positive (away from the Sun) or negative (towards the sun) sectors. Geomagnetic activity has been mostly Quiet (Kp1-2), with a single Unsettled (Kp3) interval between 04/0300-0600 UTC.

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux has been at background levels throughout. GOES16 high energy (greater than 2MeV) electron flux was at background to Moderate levels, with a peak of 514 pfu at 04/1545 UTC. The associated 24-hour fluence was below the Active threshold, on a steady, then slightly decreasing trend, with 1.65e7 integrated pfu observed at 05/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low solar activity is expected, with an ongoing chance of isolated Moderate flares on all days (05-08 Sep), most likely from AR3421.

Solar Wind / Geomagnetic Activity: Background to Slightly Elevated solar winds should increase to become Slightly Elevated or Elevated by day 2 (06 Sep) due to a coronal hole enhancement. This is one of a few fast wind influences that could occur through the period with

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similar winds likely continuing throughout. There is a slight chance of a glancing impact from a CME on day 1 (05 Sep).

Quiet geomagnetic activity is expected to become Unsettled or Active on day 1 (05 Sep) with a slight chance of an isolated G1 Minor Storm (Kp5) interval. Activity through the rest of the period is likely to vary mainly between Quiet and Unsettled, but with a slight chance of isolated Active intervals.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to remain at normal background levels. High energy (greater than 2 MeV) electron flux observed by GOES16 is currently at background to Moderate levels. Increased geomagnetic activity resulting from the onset of a coronal hole enhancement on day 1 (05 Sep) and perhaps also a glancing CME (from 01 Sep), should reduce electron counts once again. With numerous high-speed stream influences in the forecast, it should lead to periods of drop out, especially in the first few days, with a chance of enhancements to the electron flux towards the end of the period, perhaps reaching High levels, though confidence in detail is currently low for this. The associated 24 hour fluence is expected be below the Active (1e8 integrated pfu) threshold throughout the period, but with a very slight chance of exceeding this level on day 1 and day 4 (05 and 08 Sep).

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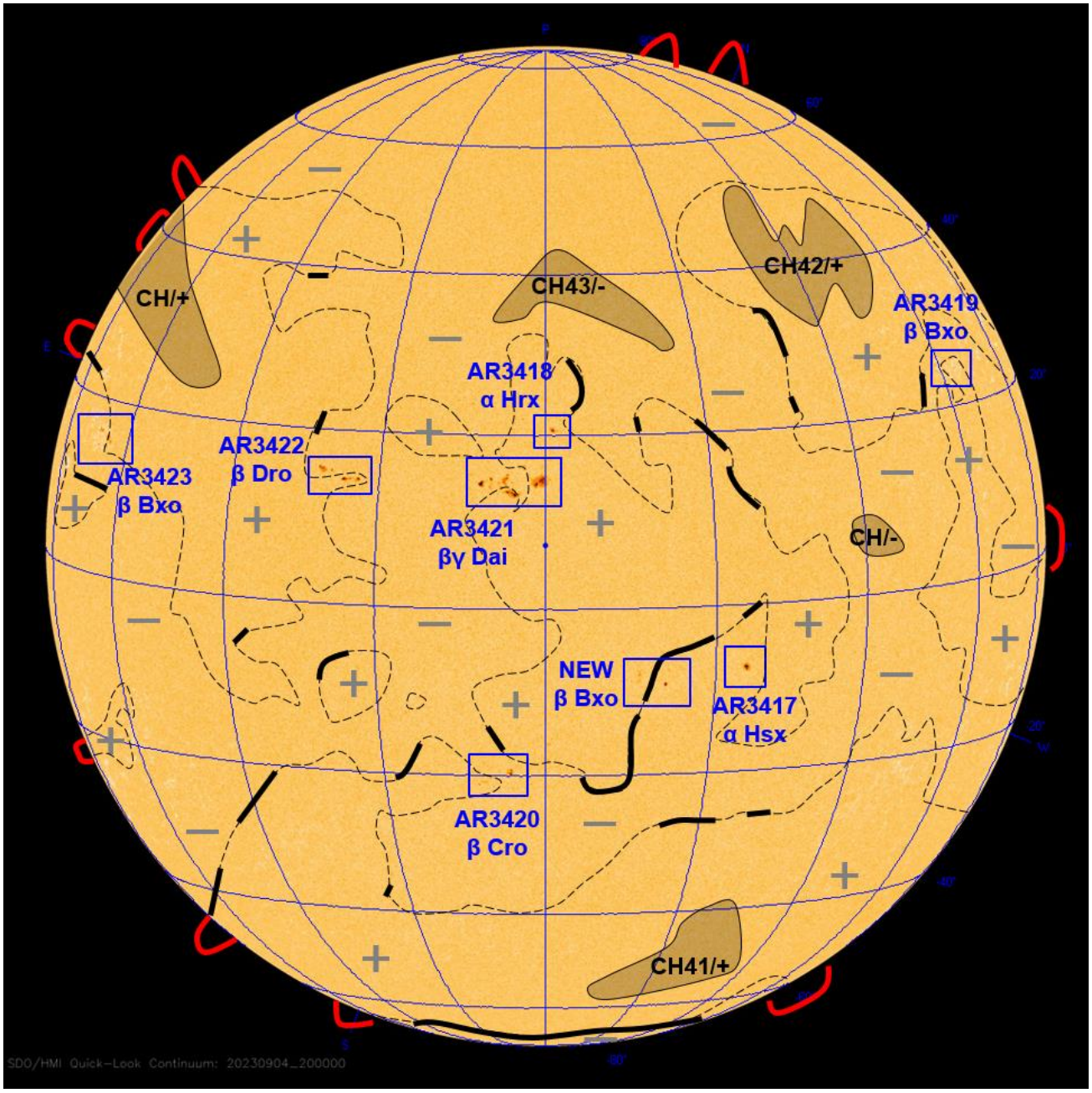
Figure 1. Solar Analysis Valid 04/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:

There is a slight chance of a glancing blow from a CME that left the sun late 01 Sep, associated with a C7.3 flare from an area of plage in the southeast. The CME has been modelled as missing mainly below and behind Earth, but peripheral effects could be seen at GEO on day 1 (05 Sep). Otherwise no CMEs currently feature in the forecast period.

Solar winds are currently between slow-ambient and Slightly Elevated levels with the easing of the enhancement from CH40/+, located in the far northwest. The next enhancement is expected on day 1 (05 Sep) from CH42/+, also in the northwest. Met Office Enlil guidance does not feature this enhancement at present, but winds at Slightly Elevated to Elevated levels are expected through much of day 2 and 3 (06 and 07 Sep). Similar speeds could persist into day 4 (08 Sep) with a number of other high-speed streams (including CH43/-) moving into favourable locations to connect with Earth, though this is low confidence.

Quiet geomagnetic activity is expected to become Unsettled or Active on day 1 (05 Sep) with a slight chance of an isolated G1 Minor Storm (Kp5) interval. Activity through the rest of the period is likely to vary mainly between Quiet and Unsettled, but with a slight chance of isolated Active intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	5	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections - Nil

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
02/0427	Partial	Flare	SE (Plage)	605 km/s	05/1200 UTC +/- 9 hours	Slight chance of a glancing impact

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Radio Blackouts - X-Ray Flares:

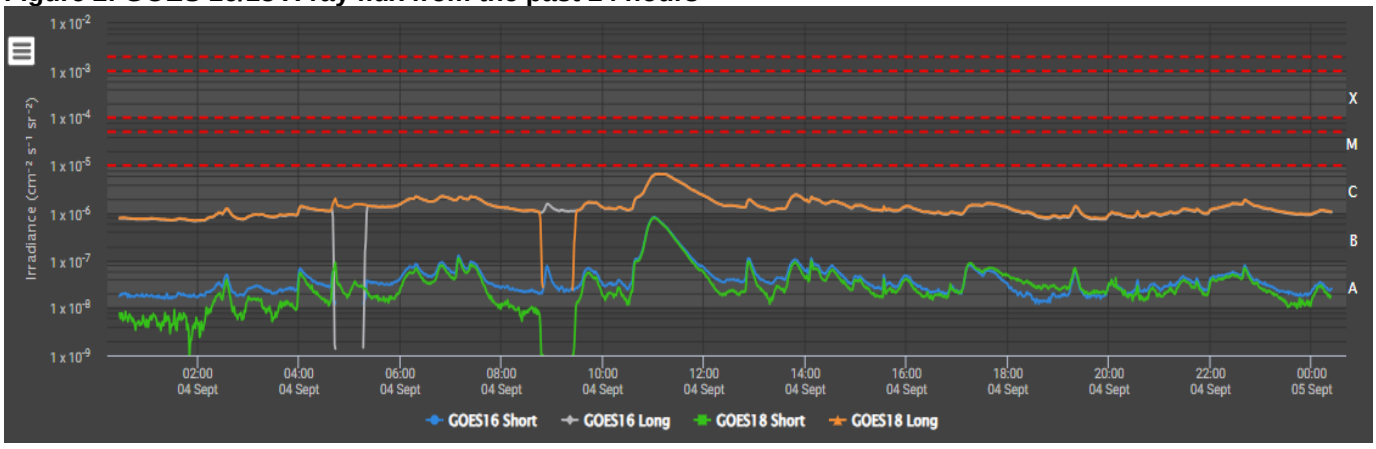
Eight sunspot regions are present on the Earth-facing side of the sun, however, the majority of these are small unipolar or bipolar groups. The main exception is AR3421 (Dai/Beta-Gamma) near north-centre disc. This region has developed most during the past 24 hours, with frequent minor C-class flaring and increased magnetic looping across the region and spot emergence. Elsewhere on the disc, most regions have remained stable or are showing some signs of decay with only a couple of new areas of growth. AR3422 (Dro/Beta) in the northeast and has seen some new spots develop, but has recently stalled in its growth. Another region, AR3423 (Bxo/Beta) has emerged from an area of plage in the far northeast. This region appears to be developing further small spots at it rotates into clearer view.

SDO aia-imagery suggests that a new region may imminently rotate over the northeast horizon. This would be Ex-AR3403 and it was responsible for some low-level C-class flaring in the middle of August on the previous rotation. Flare risks could accordingly rise from those presented here should the sunspot region still be present.

Low solar activity is expected, with an ongoing chance of isolated Moderate flares on all days (05-08 Sep).

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	25	25	25	25
Very Active	R3 to R5 X Class	No	2	2	2	2

Figure 2: GOES 16/18 X-ray flux from the past 24 hours



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Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES-16 is at normal background levels and expected to remain at these levels. There is a nominal very slight chance of an enhancement should any significant flares occur, most likely from AR3421. The risk very slightly increases into day 4 (08 Sep) as the region moves into the far western hemisphere, a region more favourable with magnetic connection to Earth.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	2	2	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy (greater than 2 MeV) electron flux observed by GOES16 is currently at background to Moderate levels. A recent response following the easing of the solar wind pressure following CH40/+ has not yet resulted in any High levels of flux being observed. Increased geomagnetic activity resulting from the onset of CH42/+ on day 1 (05 Sep) and perhaps also a glancing CME (from 01 Sep), should reduce electron counts once again. With numerous high-speed stream influences in the forecast, it should lead to periods of drop out, especially in the first few days, with a chance of enhancements to the electron flux towards the end of the period, perhaps reaching High levels, though confidence in detail is currently low for this.

The associated 24 hour fluence is expected be below the Active (1e8 integrated pfu) threshold throughout the period, but with a very slight chance of exceeding this level on day 1 and day 4 (05 and 08 Sep).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	10	5	5	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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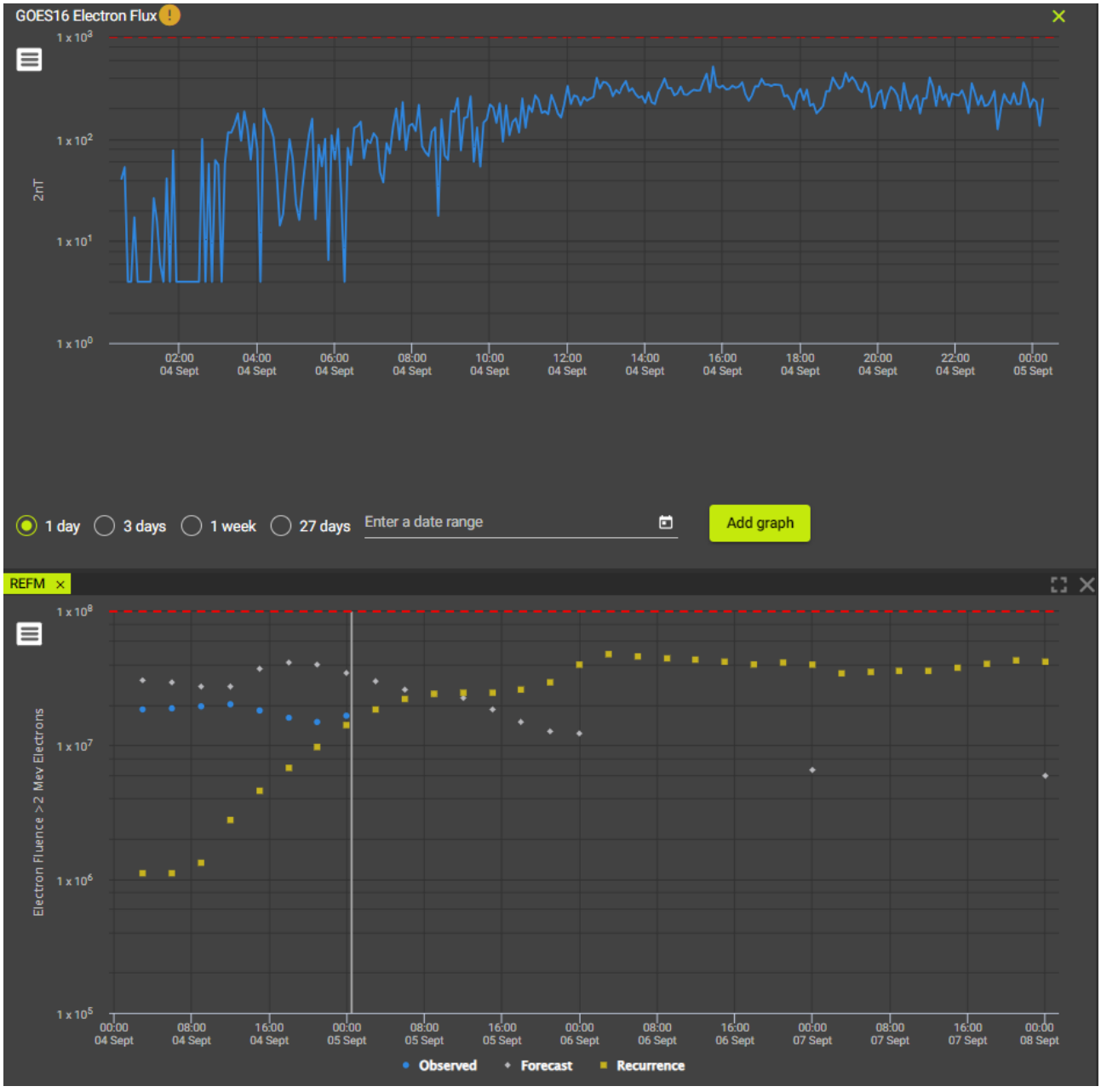
Figure 3: GOES 16 >2MeV Electron Flux (above) and MOSWOC Fluence forecast with recurrence (below)



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